The Use of Learning Analytics in a Blended Learning Context

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[DOCTORAL CONSORTIUM] ABSTRACT: Blended Learning (BL) has many opportunities for flexible learning, but it also poses some challenges. One of these challenges is to keep students motivated. As described by self-determination theory, a prerequisite for motivation are students' basic needs for autonomy, relatedness and competence. An opportunity that is often overlooked by educational scientists is the use of Learning Analytics (LA) to promote students' motivation. Therefore, the general goal of this research project is to examine if and how LA can support students' motivation in an authentic BL context in teacher education. This research goal is investigated through a mixed-method design-based research approach. Preliminary results confirm that students' initial motivation is low. Further results will be discussed, as well as implications for practice and research.

Keywords: Learning Analytics; Self-Determination Theory; Blended Learning; Teacher Education

1 CONTEXT

In teacher education the increasing diversity of students' characteristics is a worldwide phenomenon (Preston et al., 2010). Additionally, technology has become an essential part of society and offers many opportunities for education (Brand-Gruwel, 2012; Rubens, 2013). Blended Learning (BL) is characterized by a deliberate combination of online and face-to-face interventions to investigate and support learning in an instructional context (Boelens, Van Laer, De Wever, & Elen, 2015). It is important to implement BL in teacher education since it enables more flexible education responding to the earlier mentioned diversity in teacher education (Irvine, Code, & Richards, 2013; Laurillard, 2014). Besides, student teachers are the new generation of teachers who can disperse the opportunities of BL and technology enhanced learning in general (Cabero Almenara, del Carmen Llorente Cejudo, & Puentes Puente, 2010; Delfino & Persico, 2007). Consequently, BL is one of the twelve projects in the strategic plan of Ghent university (Belgium).

As stated in the BL review study of Boelens, De Wever and Voet (2017), fostering an affective learning climate is one of the key challenges in designing BL environments. A pitfall is the decrease of students' motivation during the learning process (Laurillard, 2014; Osguthorpe & Graham, 2003), especially when students' basic needs are not fulfilled (Rubens, 2013). A pilot study of Ameloot & Schellens (2018) reaffirms this and indicates that students' basic psychological needs for autonomy, relatedness and competence were not fulfilled in a BL environment. Follow-up research should investigate how to stimulate the motivational component in BL environments using LA (Ameloot & Schellens, 2018). So far, there has been a general lack of research about the added value of using Learning Analytics (LA) (Tempelaar, Rienties, & Giesbers, 2015) to promote students' basic needs.

2 THEORETICAL FRAMEWORK

2.1 Students' Basic Needs as Components of Motivation

Self-determination theory is a broad and strongly validated framework to gain insight into students' motivation (Ryan & Deci, 2000). Within this framework, motivation is classified as autonomous and controlled motivation. It is important to foster students' autonomous motivation, because this is associated with a high degree of self-determination (Vansteenkiste & Soenens, 2015) and various positive learning outcomes (Reeve, Deci, & Ryan, 2004). It is maintained that students' autonomous motivation can be increased when a learning environment facilitates the satisfaction of the basic needs for autonomy, relatedness and competence. As stated in figure 1 the basic needs can be promoted respectively by offering autonomy support, involvement and structure. These actions are consolidated under the heading of basic need supportive teaching (Vansteenkiste & Soenens, 2015).

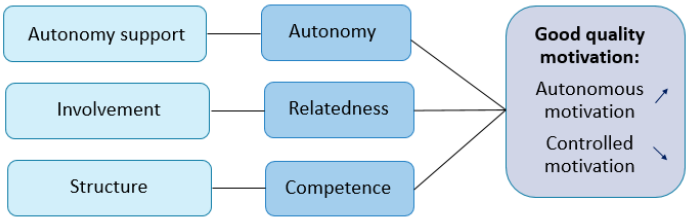

Figure 1: Basic need supportive teaching (based on Vansteenkiste & Soenens, 2015)

Research shows that there is little relatedness and autonomy in BL environments (Rubens, 2013). However, the students must be motivated to complete e.g. an entire learning path on their own. Thus, it is important to foster students' motivation in BL environments (Rubens, 2013).

2.2 Learning Analytics

Long and Siemens (2011) refer to the first LAK conference to define this concept: "LA is the measurement, collection, analysis and reporting of data about learners and their contexts, for purposes of understanding and optimizing learning and the environments in which it occurs." (p. 34) It covers a wide range of analytics and occurs on different levels of education. The focus of this study is on the micro-level, which mainly addresses the needs of instructors and students, and aims at a single course (Drachsler & Kalz, 2016; Shum, 2012). Clow (2012) describes LA as a cyclic process. This process starts with the student. The interaction between the students and the digital learning environment provides data, as for example the duration to complete a learning task, background information of students or information related to students learning activities on a Learning Management System (LMS). The data can be analysed and visualized. Through this LA, instructors might understand students' needs better, so they could provide optimal feedback and make informed instructional decisions. Based on this information, the instructor can organize an intervention (Clow, 2012). Hence, LA can impact on both students' learning and instructors' design and management of the learning environment (Mangaroska & Giannakos, 2018; Matuk, Linn, & Eylon, 2015). It is presumed that LA applied within learning design provide opportunities for more personalized learning experiences and can increase students' satisfaction (Mangaroska & Giannakos, 2018; Schmitz, Limbeek, Greller, Sloep, & Drachsler, 2017).

Furthermore, establishing and investigating the connection between what instructors do with the data and how this data is relinked to students, is essential for a good implementation (Clow, 2012). In a BL context, LA might help to narrow the gap between online and face-to-face interventions by offering the instructor insight into students' online activities (Ginns & Ellis, 2007; Tempelaar, Rienties, Mittelmeier, & Nguyen, 2018). However, the link between LA and motivation is underdeveloped (Tempelaar, Rienties, & Giesbers, 2015). Current research suggests that the use of LA needs to be investigated (Pardo, Powuet, Martinez-Maldonado, & Dawson, 2017) in order to enhance students' motivation (Rubens, 2013). In addition, little is known about which data is perceived as useful by instructors and the perceptions of students and instructors of LA (Wise & Shaffer, 2015). Research on LA design decisions, such as which data can be collected and how, is needed (Jivet, Specht, Scheffel, & Drachsler, 2018; Mangaroska & Giannakos, 2018; Verbert et al., 2014).

3 PURPOSE OF THE STUDY

LA data allows instructors to make informed instructional decisions to provide a more personalized learning environment (Clow, 2012; Laurillard, 2014; Matuk et al., 2015). Our hypothesis states that through the use of LA data instructors can enhance students' basic need satisfaction through adequate adaptations of the learning environment and offering appropriate formative feedback. Therefore, the purpose of this dissertation is to examine how LA can be used to enhance students' basic needs in an authentic BL context. Furthermore, another aim involves gaining insight into students' and instructors' general perceptions of LA. In the LAK research field, evidence-based studies in an authentic learning environment are rare. This doctoral dissertation will also help to address this research gap.

4 METHODOLOGY

A mixed method approach is used in this research project gathering both quantitative and qualitative data. A pre-post-test design is set up to collect quantitative data, through the use of both existing questionnaires such as the basic need satisfaction scale (Chen et al., 2015) and newly developed questionnaires about students' perceptions of using LA. Finally, focus groups or interviews are organized to gather more qualitative data (Howitt, 2011). The following sections focus on the research questions and the design-based research approach that is carried out in this research project.

4.1 Research Questions

The central focus of this research project is how LA can support students' basic need satisfaction in a BL context in teacher education. More precisely, the following research questions are formulated:

RQ 1: How do students teachers' experience learning in a BL context?

RQ 2.1: What are student teachers' perceptions of using LA from their experiences as student in the BL context?

RQ 2.2: What are student teachers' perceptions of using LA from their future teacher perspective?

RQ 3: What are instructors' perceptions of using LA?

RQ 5: What is the impact of using LA on students' basic psychological need for autonomy, relatedness and competence?

RQ 6: What are important design requirements and design propositions for using LA in a BL context?

4.2 Design-Based Research Approach

To answer the research questions, a design based research approach is used. This is a systematic yet flexible methodology using design, implementation and iterative analysis (e.g. intervention studies), with the goal to develop design principles and theories to improve educational practices (McKenney & Reeves, 2012). The interventions are designed and implemented in an authentic setting: in this case the course Powerful Learning Environments in teacher education of Ghent University (N = ± 300).

5 CURRENT STATUS OF THE WORK AND RESULTS

In 2016 and the beginning of 2017 a review of the literature was conducted. Furthermore, in a pilot study (December 2016, N = 164 students) a questionnaire was used to gather preliminary results about student teachers' initial basic needs satisfaction in a BL environment; items were rated on a 5-point Likert scale, ranging from 1 *completely disagree* to 5 *completely agree* (Chen et al., 2015). Based on a one-sample t-test, the basic needs for autonomy (M: 2,534; SD: 0,864) and relatedness (M: 2,707; SD: 0,780) score significantly lower ($p < 0{,}001$) than the neutral score of 3 (on a 5-point Likert scale). Based on these findings, it can be concluded that students' initial motivation is low. This reaffirms the challenge to investigate how this motivational component may be enhanced (Rubens, 2013), by using LA. In the earlier mentioned pilot study, student teachers' perceptions of using LA were gathered as well. Descriptive results indicate that these perceptions are rather diverse. The findings show that student teachers are not yet convinced about the added value of LA. Yet, it has to be noted that these perceptions are based on a hypothetical use of LA and not on student teachers' experiences, because there was no LA intervention conducted (Ameloot & Schellens, 2018).

Following up, in 2017 the first quasi-experimental intervention study was being conducted (N = ± 261 students). This intervention focusses on the proximal effect of how LA can support the basic need for relatedness. The quasi-experimental study was conducted during 3 months in module five of the course Powerful Learning Environments. In this course the module starts with an online learning path in which central concepts are presented. The second part of the module consists of a face-to-face workshop which focuses on a specific technological tool. Every workshop was organized twice both in the control and experimental condition. Participants were distributed over the control (n = 139) and experimental (n = 118) condition. In the control condition, a regular implementation of the online learning path took place and the instructor organized a general workshop. In contrast, in the experimental condition different LA were gathered and offered to the instructor, enabling the instructor to make adequate adaptations in the face-to-face workshop and offer appropriate formative feedback (see Figure 1). The design of the intervention study is illustrated in figure 3.

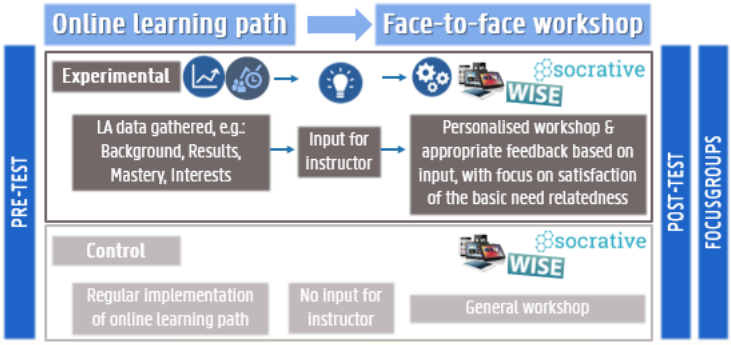

Figure 2: Design of the intervention study

The LA were gathered on group level per group of students who followed the same face-to-face workshop at the same moment. This data was displayed on the one hand on a LA dashboard and on the other hand in additional graphs because the dashboard did not generate all the data automatically. The design is guided by the framework of Self-Determination Theory (Ryan & Deci, 2000) and the LA literature (Clow, 2012; Long & Siemens, 2011). Three types of data were gathered:

1. The first type of data were *general statistics* gathered by the LMS about for example students' assignments and task on time.
2. The second type of data was gathered through extra questions about *students' degree of understanding, interests, and desires* for the face-to-face workshop. Next to multiple choice questions, also some open questions were asked to gather more enriched data. This first and second type of data is important to monitor students' learning, enabling the instructor to improve the instruction and provide appropriate formative feedback during the face-to-face workshop. By asking and using this information, students could feel more related.
3. The third type of data was information about *students' previous education and background characteristics*, gathered through extra questions and displayed in a graph. This type of data is interesting because of the highly diverse student population in teacher education (Delfino & Persico, 2007). This information should enable the instructor to personalise the face-to-face workshop, which is expected to enhance students' basic need for relatedness.

Based on a one-way repeated measures ANOVA, the results revealed no significant effects of the intervention on both relatedness within students and relatedness between students and instructor. Nevertheless, the results indicate a significant main effect for time on relatedness between students and instructor (Wilks' Lambda = .941, $F(1, 255) = 15.856$, $p < .001$). All students felt more related to the instructor than they expected beforehand. It can therefore be assumed that students positively experienced the organization of the module in general.

Overall, students' perceptions towards the use of LA are positive. Regarding the *general statistics* (e.g. students' task on time and assignments), students of the experimental condition agree significantly less with the disadvantages than students of the control condition after the intervention was conducted (Wilks' Lambda = .976, $F(1, 255) = 6.281$, $p = .013$). Students of the experimental condition are more positive against the idea that *general statistics* stimulate connectedness and personalization (Wilks' Lambda = .982, $F(1, 255) = 4.560$, $p = .034$). Table 1 presents the descriptives. It seems possible that these results are due to the positive experiences of students of the experimental condition with the LA intervention. No significant differences between conditions were found for the scale added value of LA ($p > 0.05$). Other quantitative results can be presented at the doctoral consortium.

Table 1: Descriptives for LA situation focusing on *general statistics*

Condition	Scale	Pretest M(SD)	Posttest M(SD)
Control	Added value	4.00(.61)	4.05(.50)
	Disadvantage	**2.67(.86)**	**2.78(.73)**
	Connectedness and personalization	**3.54(.63)**	**3.56(.54)**
Experimental	Added value	3.98(.71)	4.03(.66)
	Disadvantage	**2.86(.78)**	**2.72(.84)**
	Connectedness and personalization	**3.42(.75)**	**3.63(.61)**

Preliminary results based on the focus groups indicate that students clearly perceived the implementation of LA as useful. Some students argue that they preferred a specific type of data. For example, statistics focusing on *students' degree of understanding, interests and desires* was indicated as highly valuable. Besides, the majority of the students of the experimental condition found it stimulating when their needs were explicitly considered. They also experienced that the instructor had adapted the content of the workshop to their personal needs, making the adaption formative in nature (Ferguson et al., 2017). It is important that the instructor does something with the information gathered by the LA. Closing the loop through effective interventions that reach the learners is a crucial aspect in the design of LA interventions (Clow, 2012). Other implications for practice and challenges for further research can be presented and discussed during the doctoral consortium.

Based on a design-based research approach (McKenney & Reeves, 2012), the second quasi-experimental study will be carried out in October 2018. This intervention focusses on the supporting role of LA for the instructor to foster an autonomy and competence supporting learning environment. Interviews with the teachers and students are planned, in addition to the pre-post quantitative student questionnaires. Findings from this study will provide directions for further investigation.

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